DOCUMENT RESUME

ED 202 362 HE 013 875

AUTHOR Dresch, Stephen P.
TITLE A Critique of Planning Models for Postsecondary Education: Current Feasibility and Potential Relevance, and a Prospectus for Further Research.
INSTITUTION Education Commission of the States, Denver, Colo. Inservice Education Program.; State Higher Education Executive Officers Association.
SPONS AGENCY Kellogg Foundation, Battle Creek, Mich.
REPORT NO IEP-024
PUB DATE Dec 74
NOTE 66p.; Paper presented at a Seminar for State Leaders in Postsecondary Education (December 1974).

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS *College Planning; Educational Demand; *Educational Finance; *Educational Policy; Evaluation Criteria; Federal Aid; Higher Education; *Models
IDENTIFIERS *Seminars for State Leaders Postsec Ed (ECS SHEEO)

ABSTRACT

The feasibility and potential relevance of comprehensive planning models for postsecondary education are examined, focusing on the two most widely discussed models of this type: (1) the Postsecondary Education Financing Model (PEFM) of the National Commission on the Financing of Postsecondary Education, and (2) the Federal Planning Model (FPM) of the National Center for Higher Education Management Systems, Western Interstate Commission for Higher Education. The broader context within which such analyses are pursued are considered, identifying the important dimensions of the postsecondary education sector that must be captured by any prototype model. An attempt is made to provide an alternative strategy for enhancing understanding of the postsecondary education sector and the functional effectiveness of both public and private policies. Areas in which potential students and institutions directly interact include the following: admission policies, standards of academic performance, responsiveness of academic programs to labor market conditions, and pricing and financial aid policies. Important aspects of internal organization include faculty composition and the general mix of activities undertaken by faculty. The FPM includes a student demand model, which is short-run, comparatively static, and positive, and an institutional model that has both long-run and short-run and both static and dynamic components. FPM is essentially a model of a single institution. The PEFM predicts changes in the future configuration of the postsecondary system from National Center for Education Statistics benchmarks induced by specific policy actions. It is concluded that each model has major weaknesses at both a conceptual level and at the level of empirical implementation. (SW)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED202362

Inservice Education Program (IEP)

Paper Presented at a Seminar for State Leaders in Postsecondary Education

A CRITIQUE OF PLANNING MODELS FOR POSTSECONDARY EDUCATION:
CURRENT FEASIBILITY AND POTENTIAL RELEVANCE,
AND A PROSPECTUS FOR FURTHER RESEARCH

STEPHEN P. DRESCH

Yale University and National Bureau of Economic Research

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

ECS

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

December 1974

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

IEP Paper No. 024

HE 013 795

Education Commission of the States

Inservice Education Program (IEP)
Education Commission of the States
1860 Lincoln Street, Suite 300
Denver, Colorado 80295

SHEEO

The IEP Program has been supported primarily by the W. K. Kellogg Foundation with additional funds from the Education Commission of the States, the Frost Foundation and the State Higher Education Executive Officers

12 December 1974

A CRITIQUE OF PLANNING MODELS FOR POSTSECONDARY EDUCATION: CURRENT FEASIBILITY AND POTENTIAL RELEVANCE, AND A PROSPECTUS FOR FURTHER RESEARCH

Stephen P. Dresch

Yale University and National Bureau of Economic Research

> In dealing with any natural phenomenon...the mathematician has to simplify the conditions until they reach the attenuated character which lies within the power of his analysis.
>
> Karl Pearson[1]

1. Metapolicy: Research and Policy Analysis in Postsecondary Education

Perusal of much recent policy analysis and policy-oriented research in the area of higher education calls to mind (somewhat out of context) a phrase from Jurgen Habermas (1970, p.33), "[the] devaluation of theory and the overhasty subordination of theoretical work to the ad hoc requisities of practice...," a phrase which aptly characterizes much of what might be called, perhaps unfairly, the "administrative/systems sciences" approach to policy analysis.[2] Most highly developed in the urban planning-transportation-land use area, this approach represents a marriage of convenience between a) a perception of serious, unresolved questions of relevance to policy, b) generally inadequate substantive knowledge of the sectors involved (determinants of behavior and performance), c) a lack of critical concern for the underlying elements of the current situation giving rise to a particular nexus of immediate policy issues, and d) the ready availability of large-scale, computer-intensive systems (e.g., the well-known

Forrester "systems dynamics" class of models)[3] capable of obfuscating this lack of knowledge by generating masses of detailed output on the basis of arbitrary specifications of the characteristics of the system. The product of this entrepreneurial pseudo-scientism is a practical application of apparently high-powered analytical capabilities to issues of immediate import, an application which does not suffer from the uncertainties and qualifications which would be emphasized by specialists in any of the substantive areas of interest.[4]

The origin of this genre of analysis is clear: There is much that we do not know about the consequences of public policy. Thus, it is difficult to evaluate program performance and to develop and justify proposals for program modification. However, this incomplete and imperfect knowledge not withstanding, legislative and administrative decisions must be made, e.g., appropriations must be established, expiring programs must be reenacted or replaced, and discretionary administrative rulings effected.

In this context, two nominally polar approaches are generally perceived:

(1) The existing state of the art can be mined for whatever insight it might legitimately provide of relevance to these immediate issues.

(2) The most fundamental limitations and inadequacies of current knowledge can be identified, and efforts can be devoted to improving understanding in these areas.

In fact, these are not the only possible approaches. Two others, which truly are polar, constitute perhaps the most common sources of policy analysis:

(3) Someone, often for reasons totally unrelated to current policy

concerns, finds a previously ill-understood process or nexus of processes tractable (or approachable in new terms), and it happens that this progress or insignt has policy implications of particular relevance.

(4) The demand for the appearance of rationality in an area in which knowledge effectively does not exist induces an entrepreneurial pseudo-scientism of the type described above, the inadequacy of existino knowledge is obfuscated by virtual fakery, e.g., by painting black skin grafts on white rats, and answers are provided which, arbitrary and useless though they may be, confer at least the aura of justification to action.

Most analytical efforts are certainly perceived, both by the analyst and by the purchaser of the analysis, as falling somewhere on the continuum between the first and second approaches. However, when the emphasis is on moving very quickly and comprehensively toward the first, toward more-or-less definitive answers, then the likelihood of "type-three fortunate accidents," of fundamental improvements in knowledge and understandinq, will be reduced, and the pressures toward "type-four fakery" will become virtually irresistible.

This problem arises from an essential characteristic of analysis, of understanding something as opposed to simply describing it. Unlike description, analysis necessarily involves attenuation, a process of simplification which permits limited analytic capabilities to deal with the complexity of observed reality. And with attenuation goes the risk of discarding the essential and retaining the irrelevant in an arbitrary mischaracterization of reality. While the distinction between the essential and the irrelevant is a critical issue with which any science must continually deal, it constitutes a particular conundrum for the policy sciences, i.e., for the application of scientific expertise to problems of

public concern.

This is true in two senses. First, for the analyst the perception of the problem is a perception of others. For example, it is not the analyst who decides that "accessibility" is the important policy issue in post-secondary education. While the analyst may have his own perception of the fundamental issues, this perception can have meaning in terms of explicating the consequences of alternative policies only if he is able to make the case persuasively that these are the crucial issues. More commonly, he is considering a particular area at all only because those involved in designing and implementing policy perceive specific issues to be important, and in any event his counsel will be sought only if he embraces their perception. The challenge to policy analysis, both for the analyst and for the consumer of the analysis, is to recognize that immediate perceptions of the issues may not represent the most important issues over the longer term. If this recognition is achieved, then analysis can attempt to illuminate the issues currently conceived to be important while simultaneously subjecting current conceptions to critical scrutiny in terms of the evolving understanding of the sector being examined.

The second difficulty for policy analysis derives from the "immediacy" of policy concerns. Recognizing the fluidity of public perceptions the policy analysis consumer (whether political appointee, career bureaucrat or elected official) is concerned primarily with immediate explication of the options, not the long-term development of analytic capabilities. The temptation for the analyst in this context is the "sell" what he has, regardless of its underlying relevance, rather than to provide what legitimate insignt he can, subject to the limitation of his existing capabilities.

The temptation for the consumer is to self-deceptively purchase the

illusion of rationality, choosing that strategy with the highest apparent short-term payoff, even when this does not significantly improve the informational basis on which policy is made. Thus, the immediate application of state-of-the-art knowledge and technology, although of severely limited relevance and usefulness, has a strong attraction even when it is purchased at the expense of significant intermediate-term improvements in analytical power.

While this tension is invariably present in any application of necessarily incomplete and imperfect scientific knowledge, particularly dysfunctional positions on the continuum of available options have been chosen over the last decade, under the rubric of "comprehensive planning." After successive disasters of comprehensive planning in other areas in which it has been applied, it is somewhat peculiar to see these techniques optimistically and unselfcritically grasped in education policy-making, an area in which basic knowledge is even more inadequate and the system if anything even more complex.

The point is not that the development of comprehensive models and theoretical systems for postsecondary education should not be undertaken. On the contrary, a reasonable purpose may well be served by an attempt to integrate "state of the art" knowledge in a number of related areas into a coherent characterization of a larger system. Whether such a purpose is served, however, depends on the relevance and internal consistency of existing knowledge, the intellectual sophistication and honesty of the system builder, the constant awareness of the limited relevance of the product, and an explicit, self-critical recognition of the necessity for long-term improvements in underlying knowledge and analytical capabilities.

Recognizing paucity of existing knowledge, however, several considerations should be kept very prominently in mind in determining the nature of this undertaking.[5] First, it must be conceived of as involving not just integration of existing, partial knowledge and capabilities into a comprehensive, integrated framework, but rather as the simultaneous, interactive development of both the framework and its partial elements. This dual-pronged approach can be justified in terms of the potential benefit to the development of any one component of the need to explicitly consider the other components with which it interacts in the broader sectoral framework. Thus, the development of such a model must be seen first as a program of research and only secondarily as a contribution to planning.

Secondly, because this effort necessarily involves more than simple integration, i.e., because it is a research effort, it should be supported in a pluralistic manner. Alternative approaches should be encouraged, since the long-term utility and productivity of any one approach can be only inperfectly predicted at the outset. Correspondingly, support for development of comprehensive models should not be viewed as excluding support for narrower research on specific facets of the system. It is not clear that the pursuit of a general model will in the end be the most effective means of improving knowledge of the sector. Major advances in our understanding of the postsecondary education system may require significant breakthroughs in particular facets, and these may then lead in fairly direct fashion to more general increases in understanding. In short, all eggs should not be placed in one basket, and all baskets should not be comprehensive planning models.

Finally, research directed at the development of comprehensive models should be clearly recognized as of limited and qualified relevance for current policy decisions. Preliminary prototype models may be useful in

suggesting unanticipated potential implications of particular policies in a closed context, incorporating indirect, feedback effects. However, those involved in the policy process should not delude themselves (or others) into believing that such models at the current stage are capable of providing a firm basis for policy decisions. Less inclusive, more restricted and perhaps more informal policy analyses should also be employed to inform decisions and to evaluate the apparent implications of formative models.

Although I would argue that the foregoing conclusions are of critical importance in any area in which the attempt is made to comprehensively portray a complex system for purposes of informing public policy decisions, they are currently of particular importance in the area of post-secondary education. Over the next two or three decades the environment of post-secondary education will undergo radical changes, deriving from demographic and economic-technological sources. As discussed further below, the forces which underlay the rapid growth of the conventional higher education system (secular shifts in the intersectoral composition of employment and population dynamics) will be dramatically altered, with major qualitative as well as quantitative implications for both traditional and nontraditional post-secondary education. In this fluid context, it is very easy to commit a "fallacy of misplaced conreteness," perceiving past developments or temporary disequilibrium phenomena as permanent characteristics of the system. Similarly, the policy issues which appear to be most significant in a period of transition may be quickly replaced as the process of adjustment to new circumstances proceeds.

It is within the foregoing framework that this paper examines the feasibility and potential relevance of comprehensive planning models for postsecondary education, focussing on the two most widely discussed models

of this type: (1) the "Postsecondary Education Financing Model" (PEFM) of the National Comission on the Financing of Postsecondary Education (NCFPE, 1973, Chapter 6; Daryl E. Carlson et al, 1974), and (2) the "Federal Planning Model" (FPM) of the National Center for Higher Education Management Systems - Western Interstate Comission for Higher Education (NCHEMS-WICHE)(Vaughn Huckfeldt et al, 1973).

Before critically examining these two efforts, it is necessary to consider the broader context within which such analyses are pursued, identifying, on the one hand, the important dimensions of the postsecondary education sector which must be captured by any prototype model with a pretension to relevance in the current historical context, and on the other, the adequacy of available knowledge in these dimensions. Within this broader context it is then possible to seriously evaluate the NCFPE and NCHEMS models. In the process it will be possible to suggest in broad outline an alternative strategy for enhancing both our understanding of the postsecondary education sector and also the functional effectiveness of our public and private policies.

2. Postsecondary Education: An Overview of the Major Dimensions in Historical Context

Most briefly stated, an adequate conceptual model of the postsecondary education sector must incorporate the significant determinants of a) the behavior of actual and potential students and b) the configuration and behavior of educational institutions. The most serious weakness of previous research is its very partial approach to student behavior and its virtually total ignorance of institutional behavior and of the motivations to action of the agencies, especially governmental but also interinstitutional, e.g.,

accrediting boards, which critically influence the broad configuration of institutions. The lack of an adequate knowledge base in these dimensions raises serious questions concerning the current feasibility of a comprehensive model even marginally relevant to planning.

Development of adequate understanding of a system as complex as the postsecondary education sector would be difficult under any circumstances. However, this difficulty is compounded by the fact that the environment of postsecondary education is undergoing rapid change. While the process of change has had the appearance of the economist's conception of "balanced" or "Golden Age" growth, in which movements in all variables are uniform and mutually accommodating, this appearance has been the fortuitous consequence of a confluence of peculiar events which is unlikely to be repeated in the foreseeable future. Any analysis which assumes that the future will represent a simplistic replication of the past will miss the most important forces which can be anticipated to influence the postsecondary education system over the next several decades. Thus, comprehension of this changing environment is a necessary prelude to an evaluation of sectoral models and of the prior research on which they are based.

The most important factors underlying the growth of conventional higher education over the last half century can be grouped under two headings:

(1) Industrial composition, the radical change in the sectoral distribution of employment which has occurred over the recent past, especially since 1945, and is now (1974-75) virtually at an end.

(2) Population dynamics, the demographic profile of the period since 1920, characterized by the succession of (a) severely depressed

birthrates during the 1920s and 1930s, (b) the explosion of births following World War II, and (c) the steady decline in fertility which has occurred since 1960, approaching roughly zero-population-growth (ZPG) fertility rates in the early 1970s.

As I have described in detail elsewhere (Dresch, 1975a and 1975b) these factors interacted in a particularly significant manner to influence the course of development of the higher education sector. To summarize: The years 1930-1945 constituted a major break in the long term pattern of change in the sectoral composition of employment. In effect, the depression and war held in abeyance the continuation of economic tendencies which had been operative over the preceding half-century. Thus, the post-war period was one of extremely rapid change in economic structure, and the pattern of change was one which necessitated substantial increases in overall educational attainments, i.e., employment shifted disproportionately toward industries which historically had been highly education intensive. However, the rapid post-war increase in demand for highly educated labor occurred just as cohorts of educationally malleable young people, e.g., those 18 to 24, began to significantly contract, reflecting the declines in fertility during the 1920s and 1930s. Thus, a major <u>excess</u> demand for educated labor developed after the war and persisted through the 1950s and early 1960s, creating high and sustained percuniary returns to college level educational attainments. As a result college attendance rates of 18- to 24-year olds rapidly increased from 9.1% in 1940 to 20.5% in 1960 and further to 30.6% in 1970. This increase in attendance reflected not only the derived demand for education on the part of young people, in response to labor market signals, but also public policies designed to augment the institutional supply of educational opportunities, policies which were themselves a

response to the excess demand for technically trained labor as reflected in potent middle class support for a higher education system which would fulfill the rapidly rising educational aspirations induced by the labor market.

Effectively, after the war an excess demand for college educated persons, operating both through individual action and public policy, drove up the college-educated proportions of successive age cohorts. However, as the size of these cohorts suddenly and discontinuously increased after 1964 (reflecting the post-war explosion of births), the inertia in the system, operating through the proportions educated, forced up disproportionately the number of persons educated. In its origins the expansion process reflected a suddenly operative excess demand for educated labor, while in its latter phases (after 1965) the dominant factor is the rapid expansion in the supply of educationally malleable labor, the educational attainments of which are determined by an excess demand existing in the past but quickly being eliminated.

As a result of these developments the market for college-educated labor is quickly becoming saturated. The college-educated proportion of the adult population (age 25 and over), after rising slowly from 4.6% in 1940 to 6% in 1950 and 7.7% in 1960, i.e., by between 1.4 and 1.7 percentage points per decade, increased markedly to 11% in 1970 (an increase of 3.3 percentage points over the decade). Subject to very little prediction error, this proportion can be expected to reach 15% or 16% by 1980, for a 4 or 5 percentage point gain over 1970. Furthermore, these increases will take place in the face of virtual stability in the composition of employment (Denison, 1973).

As the college-educated labor market deteriorates over the decade of

the 1970s, the relative earnings gain associated with a college education can be expected to decline rapidly, inducing a decline in the college educated proportions of young people after 1980.[6] From a peak of more than 33% of 24-year-olds college educated in the early 1980s, this proportion may decline to 15% in the late 1990s.[7] And again, this probable decline will reflect not only a lessening of individual incentives to college attendance, but also a contraction in public support, especially of conventional higher education. Recently enunciated concerns for "access" and "equality of opportunity" and the shift of public concern from "higher" to "postsecondary" education are perhaps leading indicators of the future direction of public action. When there existed an excess demand for the products of traditional higher education, there was no reason to seriously consider alternative institutional foci, but with the elimination of this excess demand public support for traditional higher education will be subjected to progressively more serious question. The result is likely to be a basic change in the level and composition of student demand, accompanied and reinforced by equally significant redirections of public policy, both of which will have major consequences for the configuration of institutions and for patterns of institutional action.

3. Characterizing the Postsecondary Education Sector: Requisite Knowledge and the Adequacy of Previous Research

The essential facets of the student and institutional components of the postsecondary educational system have been suggested implicitly in the foregoing discussion. An assessment of the current feasibility of a comprehensive model of the sector must face the issue of the degree to which previous research permits the concrete specification of these facets.

3.1 Educational Decision Making and Student Demand

A general conceptual schema for the analysis of student behavior can be briefly outlined. At each stage in his (educational) career a (potential) student, e.g., a high school graduate, can be described in terms of his socioeconomic characteristics and academic attainments and aptitudes. Similarly, the objective labor market conditions facing this student, e.g., employment and earnings prospects in alternative occupations requiring various types and levels of education and training, can be identified.

For a cohort of students at a point in time these objective labor market conditions are by definition identical. However, their implications for particular students may differ. First, actual labor market opportunities facing persons with different characteristics may differ significantly. For example, the probability of admittance to and advancement in a particular career may depend critically on specific characteristics of the individual, e.g., academic achievement or socioeconomic background. Furthermore, these relative opportunities may vary systematically with general labor market conditions. Thus, in a period of extreme excess demand for persons with particular types of training and skills, particular characteristics may be much less important than in a period of excess supply.

Second, the relative labor market opportunities facing a particular individual will depend upon the characteristics of the educational system which intervenes between the individual and the labor market. Thus, while the state of the labor market determines the educational and other requirements for entrance into a career, the educational system determines

the cost of and the personal qualities and characteristics required for admission to and success in a particular academic program.

Finally, the student's subjective perceptions of both labor market and educational opportunities may not correspond to actual realities. Particularly if these conditions are changing rapidly, the individual may gauge employment opportunities or prospects for educational success on the basis of past experiences which no longer provide good predictors of current or future opportunities. Thus, there may be substantial inertia in the adjustment of student behavior to changing educational and labor market conditions.

Given the student's perceptions of alternative careers, of their educational prerequisities, and of the risks and uncertainties associated with these, he can be viewed as evaluating alternative educational-cum-career options. Concrete educational options, of course, vary in a number of dimensions. Thus, a particular educational program offered by a particular institution can be conceived as a bundle of specific attributes, and the student can be viewed as comparatively evaluating alternative bundles, relative to each other and to non-educational options. Since for at least some groups of students education may also have value apart from specific career outcomes, and also because education of at least some types may serve as a mechanism for obtaining information on career opportunities and on the student's probable relative performance in further education and in alternative careers, educational choices must be viewed as functions both of current perceptions of labor market and educational prospects and also of other characteristics (socioeconomic, etc.) of the student.

In summary, several critical dimensions of the educational decision process must be captured by any meaningful analysis: 1) the state of the labor market, including criteria for selection and advancement, facing

persons with different types and levels of education and differences in other characteristics, 2) the nature of educational options, including criteria for and conditions of admission and success, and 3) the relationship between actual conditions in these dimensions and student perceptions, and especially the process by which student perceptions are modified in response to changes in underlying conditions.

A critical implication of the foregoing is that educational decision making must be viewed as a continuing process, in which past choices constrain but do not determine current decisions and in which decisions can, within limits, be modified in response to changing external, e.g., labor market, conditions. More fundamentally, in this view it is impossible to divorce the process of educational decision making from the more general and evolving process of career formation and development over the adult lifetime.

Available higher education demand studies contrast sharply with this sketch of a general model of educational decision making. The most serious inadequacy of these studies is their attempt to explicate the process of educational decision making almost entirely in terms of the characteristics of the (potential) student alone, with virtually complete disregard for the environment within which these decisions are made, e.g., the state of the labor market for persons with different types of education and skill. In effect, this environment has been assumed to be constant and unchanging. While this characterization of the environment may have been superficially descriptive in the context of the persistent excess demand for educated labor which prevailed over the 1950s and 1960s, it is impossible to maintain this perspective in light of the progressive deterioration of the educated labor market which will be observed over

the late 1970s and the 1980s.

A number of aggregative studies have attempted to capture particular environmental influences on educational decisions. For example, Campbell and Siegel (1967) studied the effects of movements in real family income and tuition on the proportion of 18 to 24 year old high school graduates enrolled in four-year colleges, examining the period 1919-1964. Galper and Dunn (1969), using data developed by Campbell and Siegel, quantified the short-run effects of military accessions and discharges, in addition to family disposable income, on the level of enrollment. Using time series data for Canadian provinces, Crean (1973) found a significant positive relationship between unemployment rates and secondary school retention rates, a relationship also discovered by Kaun (1974) in time series data on the college completion rate in the U.S. and given limited support by Corazzini, Dugan and Grabowski (1972) in a state-level cross-section analysis based on Project Talent data.

The aspect of the educational-decision environment to which most attention has been devoted is that of tuition and other out-of-pocket costs of attendance. Campbell and Siegel (1967) found a significant negative relationship between tuition charges and the overall enrollment rate of 18 to 24 year old high school graduates. This negative relationship was observed at a more refined level by Corazzini et al (1972), using tuitions at four types of institutions (junior colleges, teacher colleges, and four-year public and private universities). Also at an aggregative level (institutional enrollment distributions of graduates of selected California high schools), Hoenack (1971) examined the probability of attendance at different types of institutions, e.g., the University of California versus state or community colleges, in terms of cost differentials

(as measured by accessibility).

However, serious problems arise in these attempts to estimate price elasticities. First, gross tuition charges, as employed by Corazzini et al are not the prices facing any individual student, since financial aid enters as a wedge between the gross and the net cost. Since financial aid is a function of tuition charges and of student characteristics, e.g., family income and/or academic ability, price and other effects necessarily become implicitly intertwined. Second, there exists a fundamental identification problem in both time series and cross-section studies, i.e. it is impossible to accurately separate supply and demand effects. Consider, for example, an across-state comparison of enrollment rates: Assume that some states "value" education and that this is reflected in a) low tuitions and b) ample educational capacity; conversely, states which do not value education maintain small educational establishments and charge high prices. If it is found, e.g., that a smaller proportion of high school graduates enter college in the second state, this may or may not reflect the price elasticity of demand. If the small-scale educational establishment in the second state raises prices to eliminate any excess of student demand over the available supply of places, then an accurate estimate of the demand elasticity may be found. But if the high price is set independently of demand, e.g., at "full cost" somehow defined, with excess student demand eliminated via rationing, then the estimated price elasticity will be an overestimate. Since highly flexible non-price criteria for the rationing of admissions are pervasive and since institutions have little incentive (or even in some cases authority) to set market-clearing prices, available estimates of price elasticities must be considered possibly seriously biased. A third problem, encountered

by cross-section studies, arises from the fact that the prices facing similarly situated individuals with similar characteristics may be identical by definition. It is for this reason that Hoenack's price elasticities are estimated on the basis of transportation cost differntials, the only component of cost which varied (and could be identified) within the California state system.

Although many of the problems remain unresolved, these difficulties have led to the recent proliferation of micro-level studies utilizing cross-section samples of individuals. The two most elaborate of these, Radner and Miller (Radner and Miller, 1970; Miller, 1971) and Kohn, Manski and Mundel (1974) have attempted to identify the determinants of college going and choice of college in terms of institutional characteristics (including price) and student characteristics, using SCOPE data. To isolate demand effects, these studies first identified "feasible sets." consisting in principle of colleges to which the student might have applied and would have been admitted. Then the choice of a particular college was assessed in terms of price and other characteristics. Because of limitations of the data, the actual procedure was less straight-forward. In the absence of knowledge of schools to which a person would have been admitted, it was necessary in both studies to "construct" a feasible set for each student. If actual applications reflect student perceptions of supply constraints, i.e., if the actual and hypothetical feasible sets differ systematically, then an identification problem may again arise, producing biases in resultant parameter estimates. Even assuming that feasible sets could be accurately imputed, these studies encounter serious problems in the estimation of demand functions. Since neither Radner-Miller nor Kohn et al were able to identify actual financial aid offers facing different individuals at

different schools, they were forced to employ gross costs as the price variables. Because financial aid varies systematically with family income and with total cost, the estimated price and income elasticities cannot be interpreted apart from the aid-income-price relationships implicitly prevailing in their sample.[8]

The superficially most attractive feature of the Kohn et al study is its explicit incorporation of the alternative of not attending college. For Radner-Miller this option was simply represented as a "college" of low academic standards and an implicit price of minus $3000 (prices of all "real" colleges for all individuals were increased by $3000, to reflect foregone earnings, while the price of non-attendance was set at zero). Kohn et al more appropriately break the choice process into two stages. In the first the "best" college is selected from the feasible set facing the individual, while in the second this best college is compared to the alternative of not attending any college. However, no attempt is made to characterize the non-college alternative, in terms, e.g., of expected earnings or the probability of unemployment, and hence the probable effects of changes in non-college opportunities facing a potential student cannot be anticipated.

Thus, both aggregative and micro-level studies are of seriously limited value. Neither has meaningfully incorporated estimates of the consequences of pursuing alternative education programs, e.g., probability of successful completion, employment and earning prospects. While the more aggregative analyses have attempted to capture important environmental effects ignored in the micro studies, e.g., the effects of unemployment rates, foregone earnings, and military manpower demands, their estimates of price and income elasticities and socioeconomic effects are of limited

value because the analysis is at such a high level of aggregation. For example, in assessing alternative public tuition or financial aid policies, the aggregate cross-section or time series studies are of marginal relevance to policy, even assuming that they have appropriately identified price elasticities of demand. The focus of interest is on changes in the educational choices of particular sub-groups of students, not on overall enrollment rates; two policies which have identical aggregate effects may differ significantly at a disaggregated level, and public policy may well not be indifferent between them.[9] However, although they permit the assessment of particular policy changes at a high degree of disaggregation, the micro-level studies have captured fewer of the important elements of the environment which impinge upon educational decisions and hence are useful only in a context in which the environment is unchanged, i.e., they implicitly assume that the future will replicate a particular past.

The limited range of educational decisions examined by both types of studies is as severely restricting as their internal inadequacies and limitations. With the exception of Kaun's (1974) study of college completion (and of Crean's (1973) analysis of secondary school retention rates), all of the studies mentioned thus far have focused on either a) the first time enrollment decision of high school graduates (usually further restricted to enrollment in the academic year immediately following high school graduation), as in Corazzini et al, Radner-Miller and Kohn et al, or b) the enrollment rate of a particular population group, e.g., 18 to 24 year old high school graduates, as in Campbell-Siegel and Galper-Dunn. Because the age-group enrollment rate studies collapse both initial application and entrance and later persistence decisions into a common

analysis, while considerations underlying these various decisions may be quite different, the studies focused on first-time enrollment of high school graduates, by collapsing only the first two of these decisions, do represent a step forward. However, the increasing popularity of the first-time enrollment decision as a focus of study has been accompanied by an implicitly biased view that this is the only important decision, independent of the prior application decision and different in some sense from later educational decisions.

Thus, a complete specification of the demand for higher (or post-secondary) education would specifically consider not only the initial enrollment decision but also the prior application decision and the decision of a person already enrolled to persist and the type of program in which to persist. While Kohn et al casually mention the application decision as an important, self-selecting stage in the educational decision process, they choose to ignore it in their formal analysis, including "in the feasible set all those colleges to which the student <u>might</u> have applied and to which he would have been admitted" (Kohn et al, 1974, p. 7; emphasis in original). Spies (1973) has explicitly considered the application decision, identifying a number of socioeconomic and academic characteristics that importantly influence the decision to apply to a particular type of school. However, no attention has yet been devoted to the dependence of the application decision a) on prior student perceptions of the probability of admission and of his subsequent academic success, two factors ultimately under the control of institutions, b) on changes in these perceptions in response to changes in institutional action, c) on the mix of programs available at an institution, etc. These are issues on which previous research is notably silent but which will become increasingly important

as patterns of demand begin to change significantly in response to changes in the environment and as institutions are forced to alter past patterns of behavior, developments which are discussed further below.

With the exception of Kaun's (1974) aggregative time-series study of the college completion rate, the determinants of persistence have been almost totally ignored. When perhaps one-half of first-time students fail to complete degree programs in which they had enrolled, the paucity of evidence on the factors influencing persistence is particularly striking. Only recently, most notably in the study by Astin (1972), has significant effort been devoted even to descriptive analyses of the socioeconomic characteristics of college drop-outs in different institutional environments. The limited attention given to persistence again reflects the lack of a general conceptual model of educational decision making. If the determinants of initial enrollment are conceived, although vaguely and inadequately, in terms of a "demand" for education, non-completion of college programs is viewed as a pathological phenomenon, not explicable in the same terms as the initial decision to attend college.

The question of what in a particular college experience a student is actually choosing, at the stage of initially applying, of matriculating and of persisting, has been subjected to even less serious study. The most refined demand studies ultimately rely on simplistic institutional classifications, e.g., public versus private, two-year versus four-year versus university, teacher versus comprehensive, perhaps augmented by indices of academic quality (average SAT scores), characteristics of student life, and cost. In fact, of course, schools vary in a number of other dimensions,

e.g., academic and vocational mix of programs, which may be very significant for student choice, especially when external, e.g., labor market, conditions undergo marked change. While these dimensions may be important at the application and matriculation stages, they are probably of even greater significance later in the college career, when educational decisions begin to markedly restrict career opportunities and become, to a greater degree, irreversible. The bearing of these considerations for persistence, although it has been ignored, is particularly important: Ultimately it may be impossible to assess persistence independently of the program in which to persist and of the constraints imposed by past decisions on the range of program options currently available to the student. However, with the exception of Freeman's (1971) examination of labor market influences on the field distribution of college seniors and first-year graduate students and of Cooley's (1963) longitudinal study of the career development of scientists between the seventh grade and graduate school, the factors entering into these more refined educational-career decisions have been subjected to almost no serious study.

Particularly as present and expected future labor market conditions undergo significant change and as the menu of educational options diversifies, it becomes critical that an adequate conceptual framework portray more comprehensively these various aspects of the educational decision process. Even for a model directed only toward conventional, academic higher education, predictions which ignore the general decision process will be grossly inadequate. As this movement toward a more comprehensive framework occurs, it will become possible (and simultaneously it will be necessary) to consider the educational decisions of persons other than current high school graduates and those already in college (or other

postsecondary programs). This is especially true of a model which purports to deal with the postsecondary system as a whole, but even within more restricted academic confines, one of the major tradeoffs of the future may be between a concentration of education at the "college age" and increased mobility between education and work over the life-cycle.

The inadequacies of previous demand studies and their failure to develop a general conceptualization of the educational decision process may derive in large measure from the unavailability of appropriate data. Clearly, a thorough explication of the determinants of educational decisions must ultimately focus on the individual (potential) student, i.e., must be pursued at the micro level. However, micro studies have been restricted to single cross section samples of students or to longitudinal samples from a single cohort of students. Given such limited data, it is by definition impossible to explicate the role of environmental factors, e.g., labor market conditions, for student decisions, since at a point in time all persons necessarily face the same objective environment. The only issues which can be addressed within these confines relate to the role of different student characteristics in determining a course of action within a particular environmental context.

Over the decade of the late 1950s to the late 1960s it might not have seemed important to examine the effects of the environment on educational decisions, and in any event such a task would have been difficult, if not impossible, since available evidence suggests that the environment did not undergo marked change and the menu of available educational options remained basically constant.[10] However, the entire context of higher-cum-postsecondary education has undergone rapid change

since the late 1960s, and simultaneously the range of educational options has been dramatically broadened, but no serious attempt has been made to assess the implications of these changes for student educational decisions, and more disturbingly, no attempt has been made to identify the types of data which would be critical for such an analysis. As a result, it is likely that meaningful progress in this area will lag substantially the recognition of its importance, since relevant data will not have been generated.

The broad conceptual overview of the educational decision process set forth at the beginning of this section can be used to suggest operationally the specific analyses which should be undertaken and the types of data which will be required. The most convenient starting point for analysis would seem to be the age cohort. Because educational decisions are cumulative and, to a degree, irreversible, the cohort should be followed from a relatively early age.[11] For example, Campbell and Siegel(1967) and Jaffe and Adams (1964) have shown that the proportion of high school graduates attending college changed very little over the last century. Thus, since high school graduation is a prerequisite to and is motivated by college entrance, to explain increasing rates of college attendance for an age cohort requires that the deteriments of high school completion be comprehended simultaneously. Differently stated, deteriorating incentives for college attendance may appear not in a decline in the proportion of high school graduates entering, attending or completing college, but in a decline in high school completion.

At any point individual members of the cohort (or of a representative sample of the cohort), identified by personal and socioeconomic characteristics (including educational attainment and aptitude), perceive

opportunities for employment, with or without further education. These perceptions can be expected to be determined by past experiences of the individual and his cohort, and of past cohorts. Similarly, perceptions of educational options, including prospects for admission and success, can be viewed as functions of the same types of past experiences. Thus, an initial stage in the research would identify the process by which perceptions of employment and educational opportunities are determined and by which these perceptions change in response to changing labor market and educational conditions. This would involve examining employment-cum-educational perceptions of successive cohorts and of individual cohorts over time as underlying conditions change, i.e., a "time-series of longitudinal samples."

The great advantage of this approach is that it would permit the analysis of successive educational decisions of emerging subgroups within the cohort. Thus, if the cohort began at, e.g., the tenth grade, the factors entering into high school completion (and into the choice of type of high school program, etc.) could be assessed. Those not completing high school could then be followed, addressing such questions as the determinants of later high school completion, of the acquisition (on- or off-the-job) of technical training, etc. For those completing high school, the analysis would be concerned with the determinants of further education: the types of colleges or educational options considered (the application decision), and the factors influencing the ultimate educational choice (the matriculation decision), at both stages identifying trade-offs between various aspects of available educational alternatives as perceived by the student. Note that this would involve characterizing educational options in a much more refined and functional manner than has been attempted previously; in contrast, it would necessitate the identification of those

aspects of college alternatives which students perceive to be important, e.g., academic/vocational mix of programs, job placement services, extra-curricular and social activities, etc. Those persons selecting particular types of educational options could then be followed, identifying the determinants of persistence, the choice of particular programs in which to persist, subsequent labor market experience, etc. Similarly, those not immediately pursuing further education could be followed in terms of their labor market experiences and later educational activities.

The foregoing clearly describes an ambitious, large-scale program of continuing research. However, it need not be perceived as (1) an all-or-nothing program and should not be perceived as (2) the preserve of a single research group. Furthermore, (3) appropriately institutionalized, the data generation process need not be inordinately expensive, in contrast to the succession of "stand-alone," large-scale special-purpose studies which have been undertaken over the last decade and a half. With reference to the first, a simple focus on, e.g., successive cohorts of high school graduates, examining the relationship between their labor market and educational perceptions, on the one hand, and their educational decisions, on the other, would be consistent with the broader perspective but of much more limited scope.[12] The point is simply that all questions need not be answered simultaneously, but that the general approach should be one in which there is at least a fair prospect that knowledge will be cumulative. In contrast, the current state-of-affairs is one in which each higher education demand study is simply a ding an sich to be forgotten when the next study, based on the next body of expensive but inadequate data, is published.

The second point, suggesting a pluralistic research approach, is

particularly important. The impetus to previous large scale studies has come from policy makers who demanded answers to particular (not necessarily appropriately cast, important, or relevant) questions, and/or from "policy analysis entrepreneurs" who promised "success" in providing answers to such questions. The only requirement was argued to be the devotion of sufficient resources to the task. That is, the solution was simply perceived as "technological". If basic knowledge of educational decision-making had been adequate and if the only problem had been to obtain, e.g., precise estimates of price elasticities of demand, then this approach might have been reasonable. But in fact this basic knowledge has not existed, and the allocation of resources has been dominated by attempts at "applied science" without the benefit of basic scientific knowledge (or with the benefit only of individual guesses about the actual character of the basic processes involved). In short, as research rather than application, the process should be pursued in a manner which does not result in a single, necessarily blindered approach.

Finally, on the subject of cost, especially of data development, three considerations are relevant. First, as before, the design of an adequate data system need not be all-or-nothing. Just to begin to assemble relevant data for samples of current cohorts would be a great step forward and would provide the basis for cumulative data development. Secondly, the more rigorous use of scientific sampling techniques, such as those employed by the U.S. Bureau of the Census in the Current Population Survey, would greatly reduce the sample sizes commonly employed in previous large-scale educational surveys, e.g., Project Talent. Third, the current reliance on stand-alone data collection efforts, of which the National Longitudinal Survey is the most recent (Fetters, 1974),

must be recognized as inefficient and a barrier to the development of an adequate data base. The most obvious structuring of this type of on-going data collection process would be within the Bureau of the Census as part of a possibly augmented Current Population Survey. Combined with other data collection activities, the cost of a representative sample would be greatly reduced. While significant progress can be made without the construction of a comprehensive data base which follows successive cohorts over time, this is clearly an objective to be sought. Such a data base must (and can) be developed in a form which does not render it prohibitively expensive.

3.2 Institutional Behavior and the Supply of Educational Opportunities

The importance of adequately comprehending the institutional side of the postsecondary education system has been suggested repeatedly in the foregoing discussion of educational decision making. If the potential student is viewed as: 1) surveying possible educational options, weighing these in terms of a) ultimate career outcomes, b) other aspects of the educational experience valued by the student, c) the probability of admission and success, and d) the conditions of attendance, e.g., cost and financial aid; then 2) actively applying for admission to some subset of these; and finally 3) choosing from among those willing to accept him, the pervasive influences of institutional action become obvious. What is included in the existing range of educational options? What types of programs are institutions supplying? What criteria do institutions impose for admission and for academic success? What are the conditions of attendance (tuition, financial aid, etc.)? All of these are questions which are answered by institutional action, and

while institutional practices may be taken as exogenous data in the assessment of individual educational decision making, a thorough understanding of the sector clearly necessitates that the determinants of institutional action be incorporated.

A number of dimensions of this student-institution interaction can be suggested:

Admission policies. If the decision to apply is at least partially a response to expectations of the likelihood of admission by an institution, then any change in institutional admission standards will, with a lag, be reflected in student applications. Thus, it is important to identify the determinants of admission practices, assessing likely responses by different institutions to changes in levels of applications and enrollment.

Standards of academic performance. Required academic performance in different institutional environments will have important consequences for application, matriculation and persistence decisions of students. For example, application, matriculation and enrollment effects of a reduction in admissions standards will depend on whether the loosening of criteria for admission is accompanied by 1) higher attrition, 2) a decline in academic quality and standards of performance, or 3) the inauguration of special programs designed to compensate for the reduction in admissions standards. Academic standards of individual institutions and of the sector as a whole have clearly changed over time, but the causes of these changes have been almost totally unexplored.

Responsiveness of academic programs to labor market conditions. The degree to which institutions attempt to modify programs and alter the

internal allocation of resources in response to changing societal demands for persons with different types of education and training will similarly influence application, matriculation and persistence decisions of students. Some indicative evidence suggests that institutions have responded to changing student and labor market demands (Freeman, 1971), but such questions as the mechanisms of the response, the types of internal constraints encountered, and the importance of absolute growth for institutional malleability have been given only cursory consideration (Dresch, 1975c).

Pricing and financial aid policies. As is evident from the emphasis in the student demand literature on the estimation of price elasticities of demand, the tuition and financial aid policies of institutions have major implications for individual educational decisions. However, the process by which these policies are determined and the factors to which they respond have been given little attention in the literature. Do institutions respond to changes in applications and in enrollment by modifying nominal tuition charges and/or financial aid schedules? What effects do such changes have not only for potential applicants and matriculants but also on persistence for already enrolled students? Until these issues are illuminated, knowledge of the postsecondary education system will be seriously incomplete.

The foregoing is simply a partial list of dimensions in which potential students and institutions directly interact. However, it should be noted that these dimensions are not independent of each other or of other aspects of institutional organization and behavior. Interdependence is suggested by such questions as: What are the characteristics of trade-offs between admission and post-admission academic standards, on the one hand, and the

levels of prices, on the other, or between the level of prices and the level and composition of financial aid? To what degree are these trade-offs different for individual institutions than for classes of qualitatively similar institutions? To the degree to which they differ, is it possible to employ collusion between institutions to reduce competition? Similarly, as noted above, trade-offs between selectivity in admissions, rates of attrition, academic quality, and remedial or compensatory programs enter into institutional responses to changes in the level and/or composition of demand and have marked implications in such important dimensions as the composition of students by field and level (e.g., lower division versus upperdivision undergraduate).

Issues of internal college and university organization enter critically into the determination of the quantitative and qualitative characteristics of the supply of educational opportunities. Several important aspects of internal organization can be briefly outlined and are suggestive of the nature of these issues:

Faculty composition: The determination of the composition of faculties is particularly important for the academic and career mix of programs offered by an institution and for the qualitative character of those programs. Yet, little is known about the considerations which enter into the distribution of faculties over fields or over ranks and levels of training, e.g., junior/senior, PhD/non-PhD. While these determinations are related to other aspects of institutional activity, e.g., the graduate/undergraduate/professional composition of the student population and the level of reserach efforts, these relationships have rarely been explicitly examined in other than a simplisticly descriptive manner. Similarly, the conditions under which the composition of faculties can be modified, the

constraints on changes in composition and the frictions encountered, have not been explored; that is, the degree of malleability and the terms on which faculty mix can be altered may depend on a number of variables, e.g., the state of the academic labor market and the rate of institutional and sectoral growth, which may change significantly over time. Thus, for example, the existence of tenure rights may not represent a significant barrier to a desired change in the field composition of faculties in a period of rapid overall expansion but may be seriously confining in a period of stability or contraction. Until such issues have been seriously studied it will be impossible to meaningfully comprehend the determinants of such important processes as faculty promotion and retention-attrition, changes in which may be vitally important over the next several decades.

Activity (student, research et al) mix. As indicated, the composition of faculties cannot be considered apart from the general mix of activities supplied by the institution. As I have argued elsewhere (Dresch 1974a), the college or university does not provide a single, undifferentiated product, but rather is engaged in a broad range of public service (e.g., planning, consultation, program management) and research activities and in similarly differentiated educational activities (e.g., graduate, undergraduate, and professional, with further differentiation by field of study and occupational focus). The important point is that the "production processes" of these diverse activities are not independent. For example, the supply of graduate educational opportunities is intimately related to levels of research and of undergraduate instruction. And because of these interdependencies decisions about activity mix feedback into decisions concerning prices and financial aid, e.g., levels of graduate relative to undergraduate tuition, faculty composition, e.g., senior research faculty

versus junior teaching faculty versus graduate teaching assistants, etc.

The foregoing specifically implies that an adequate model of institutional behavior cannot take, e.g., tuitions, student or faculty retention or promotion rates, or graduate/undergraduate mix, either actual or desired, as given and independent of other facets of institutional behavior. Furthermore, institutions cannot be simply classified according to their internal configurations at a particular point in time. Under certain circumstances, e.g., the rapid growth of the 1960s, two-year and teacher colleges may experience strong incentives to "behave like," and upgrade themselves into, four-year comprehensive colleges, while the latter aspire to university status, and primarily "teaching" universities emulate major research institutions. Under other, less bouyant, circumstances incentives may be quite different.

While the discussion has focused thus far on traditional institutions of higher education, concerning which knowledge is notoriously inadequate, to turn toward the remainder of the postsecondary sector, proprietary, non-profit and public "vocational" and "continuing" education programs, is to encounter an almost total void. Only recently have any attempts been made even to comprehensively describe the sector, its institutions, programs, students and faculty (Nolfi and Nelson, 1973; Youn, 1974). These studies have graphically protrayed the internal differentation of the non-traditional sector. However, it is still not possible to accurately measure, much less predict, the responses of the sector to changes in, e.g., student demand.

A major component of the environment impinging upon both traditional and non-traditional institutions consists of policies and programs of numerous public and private agencies, e.g., federal and state governments,

foundations, private donors, accrediting agencies. Consider, for example, the actual or potential effects of proposed Federal Trade Commission regulation of the proprietary sector, of the recently announced decision by the New York State Commissioner of Education to terminate doctoral programs at a number of public and private universities in that state, of federal matching of state scholarship awards, of increases in educational benefits under the GI bill, of the Ford Foundations's major program of support for black colleges, ad infinitum. If our capacity to characterize the determinants of institutional action is virtually non-existent, then it is impossible to assess or predict the impacts of these actions for the postsecondary education system, much less identify the motivations to action of this complex of institutions and agencies.

One explanation for the extremely redimentary state of our knowledge of the broadly institutional facet of the postsecondary sector is the virtual nonexistence of a useful conceptual framework for the analysis of the behavior of any type of public and/or non-profit institution. Thus, the comprehension of the determinants of institutional action in, e.g., the health care sector, also dominated by public and voluntary, nonprofit institutions, is no more highly developed than our understanding of the postsecondary education sector. For this reason the preceeding discussion of the institutional side of sector is more eclectic, less structured, than the discussion of student demand.

It is not clear at this stage how the various elements of institutional action which have been identified should be integrated into a comprehensive model of the postsecondary education sector. It is clear, however, that these types of issues must be addressed if such a model is to be developed. Furthermore, any ad hoc representation of the interrelationships inherent

in institutional action can serve only as a framework for further research, not as a substitute for this research.

Research resources have been increasingly focused on the general problem of institutional behavior in not-for-profit sectors, and theories of institutional action in these sectors comparable to existing theories of the firm in the private, for-profit sectors are in the process of development (Niskanen, 1971; Migue and Bèlanger, 1974: Nelson and Krashinsky, 1974). As this general body of knowledge cummulatively develops, it will hopefully become possible to more thoroughly comprehend the nature of instituitonal behavior in postsecondary education.

The important question, of course, is whether research of this type directly focused on the postsecondary education sector can be most effectively pursued in the context of broader, comprehensive models or in the form of individual, more narrowly focused studies. My own quess is that at this stage more restricted studies of individual facets of the system will make a greater contribution to our long-term understanding of the post-secondary education system. The fact that such studies are partial need not imply that they ignore significant interactions in the system. Rather, by breaking the required research into more limited modules, they offer at least the hope that as the understanding of these modules is improved, it will become possible to integrate the components into a more comprehensive view of the complex of interactions which characterize the system.

4. The NCHEMS-WICHE and NCFPE Modelling Efforts

A critique of the NCEMS-WICHE Federal Planning Model (henceforth FPM) and of the NCFPE Postsecondary Education Financing Model (PEFM) is implicit in the foregoing broad-brush outline of the important elements which must be incorporated in any comprehensive portrayal of the postsecondary education system. This section breifly examines each of these, identifying its adequacy in terms of its own objectives and in terms of its more general usefulress as a research and as a planning framework.

Unlike the PEFM, the FPM is proclaimed by its developers to be a comprehensive model of the postsecondary education sector, or at least a "design" for such a comprehensive model. Although the institutional component of FPM is more complex, the model incorporates both supply and demand components, and it is difficult to determine which component is more reliable as a description of the workings of the system. Because FPM is more comprehensive than PEFM, and because the two are quite similar in a number of respects, it is most efficient to first examine the NCHEMS effort and then to assess the NCFPE product.[13]

4.1 NCHEMS-WICHE Federal Planning Model

At the most general level the design of FPM is subject to criticism on grounds of confusion concerning the functions of the model and the types of questions it attempts to address. In the specific case of accessibility to higher education, the ostensible focus of FPM, this issue can be posed in three essentially different ways:

(1) Given the size and qualitative characteristics of the college-age population, how would the size and composition of the student and

and nonstudent populations be altered were policy to be changed and a) were all students and institutions to completely adjust, or b) were certain adjustments (e.g., addition of physical capacity) precluded? In both variants this question is one of comparative statics, either long or short run. The question is effectively one of contrasting the "new" with the "old" state of the world.

Depending on the degree of elaboration of a comparative statics model the impacts of a specified change in the system, e.g., a change in policy, may be assessed in qualitative terms, e.g., the sign of the change in enrollment for a particular group of potential students, or in quantitative terms, e.g., the magnitude of the change in enrollment. However, in the latter case the estimated impacts cannot be considered predictions of the effects of the specified policy change since the ceteris paribus (all else equal) assumptions of the model will necessarily be violated in the real world, e.g., labor market conditions will change, and furthermore, the model says nothing about the manner in which the specified change in the configuration of the system takes place over time, i.e., the model is restricted to the "beginning" and "end" points of the process and does not purport to specify the temporal sequence of events by which the transition is made.

(2) Holding constant the "external environment," e.g., demographic and economic factors, how would the transition from the "old" to the "new" state of the world, in response to a change in policy, take place? This is a question of dynamics, concerned with the way in which institutions and individuals adjust in time to changed circumstances, identifying the times paths of changes in, e.g., faculties, physical plant, and enrollment. Thus, dynamic analysis addresses different questions than does the comparative static analysis, attempting to characterize the temporal process

by which a change in, e.g., a policy variable will induce changes in the configuration of the system.

(3) Given the way in which the external environment is likely to change, can the characteristics of the higher education sector over time be predicted? Will the history of the sector be significantly different under alternative policy configurations? The objective here is projection, comparable, for example, to economic projections of employment and income.

Clearly, these three modes of analysis may be overlapping: Dynamic analysis may incorporate an "equilibrium state" toward which the system is moving; and with adequate information on the way in which the "external environment" is changing, dynamic analysis may become predictive. However, none of these modes need necessarily be relevant to or presuppose the others. The comparative static analysis of equilibrium states need not consider the question of how, in fact, the transition from one equilibrium state to another is made. Analysis of dynamic behavior can be pursued without any prior conception of an underlying equilibrium state toward which the system is tending. And predictive analysis can proceed without a firm conception either of equilibrium or of the precise way in which changes in the environment are translated into responses by institutions or individuals (although in the extreme this may be somewhat farfetched, taking the form, e.g., of H. S. Jevons' (1910) predictions of economic phenomena on the basis of sun spots).

Cutting across these modes of analysis is the distinction between the positive and the normative. The normative issue of how colleges, students, faculty et al should behave is distinct from the positive issue of how they do in fact behave. Also, an evaluation of their behavior from a social point of view is separable from an evaluation

in terms of their own interests. Thus, the assumption of profit maximization is employed in the theory of the firm as a tentative description of the motivations of an enterprise. In contrast, in welfare economics profit maximizing by competitive firms is given a normative justification in terms of the ultimate efficiency of the economic system in the allocation of resources. Profit maximization by a monopolist (or budget maximization by a government bureau) may have a normative justification for the monopolist (or bureau) but is at best purely descriptive in terms of the social resource allocation process.

The most serious flaws in FPM derive from confusion concerning these overlapping varieties of analysis. The student demand model is very short-run, comparatively static and positive: For example, non-college alternatives are assumed unchanged, and student choices are not subject to revision if expectations are not fulfilled (no "recontracting" in response to excess demand is permitted),[14] and no attempt is made to evaluate student behavior. On the other hand, the institutional model has both long- and short-run and both static and dynamic components. Also, the structure of the institutional model is narrowly normative, lifted almost whole from its original context of attempting to identify "appropriate" behavior for a single institution (Wagner and Weathersby, 1971). The fact that it is essentially a model of a single institution is particularly critical: Even assuming that institutions do behave as the model says they should, nothing insures that the outcome of the process for a single institution (holding the behavior of all other institutions fixed) will look at all like the outcome when all institutions attempt to change in the same

directions. For a parallel, at prevailing prices an individual farmer may want to purchase more fertilizer and increase his grain production by ten percent; if all farmers try to do this, they may simply bid up the price of fertilizer, with a small or nonexistent effect on total output. In the FPM context, a single institution may be able to add PhD faculty at currently prevailing salaries, but if all institutions attempt to do so, the only consequence may be an increase in salaries of PhDs. In the time dimension, institutions are assumed to operate with a relatively long-term perspective, with an emphasis on augmentation of physical plant. But, simultaneously, the model is extremely short-run in its assumptions regarding enrollment, e.g., in the assumption that institutions make no attempt to respond to (positive or negative) excess demands.

In its entirely the model was obviously intended by its developers to be primarily predictive, thus, a federal "planning" model which would permit policy makers to anticipate the consequences of policy alternatives. This is indicated most clearly in the discussion of "Future Research Necessary" (Huckfeldt et al, 1973, Chapter VI, pp. 73ff), where the emphasis is on data "refinement," pilot testing, and "modifications" of the model within its existing structure, with extension to all of postsecondary education and further refinement and increased dimensionality as later objectives. Thus, the primary objective is a) to make the model as comprehensive and inclusive as possible and b) hopefully juggle parameters to make it "track" available observations as closely as possible. At no point does a reader get the impression of any self-critical concern for the fundamental adequacy of the internal structure of the model or of any of its components. While a number of

specific reservations and complaints with FPM will be documented below, the chapter on future research is the most disturbing, and warrants an explicit reaction. It requires a heroic leap of faith to accept the basic framework of FPM as an acceptable structural characterization of the "academic" higher education system, much less to believe that it can be adequately adapted to the entirety of postsecondary education.

The following comments and criticism of specific facets of the model are not meant to be exhaustive; rather those elements are emphasized which appear to be most critical to a comprehensive view of the higher education system.

Student sector (first-time participants). This component of the model is taken directly from the Radner-Miller study discussed above (Radner-Miller, 1970; Miller, 1971), and the weaknesses and limitations of that study are carried directly into FPM. Net tuition levels (determined in the institutional segment of the model simultaneously with institutional supply of places, as discussed below) determine enrollment demand of high school graduates, identified by academic achievement and income class. At the outset the authors of FPM indicate that a complete model, in predicting educational choices, would compare the utility to be derived from the full range of educational and non-educational options. However, they conclude that this "requires much more information than is actually needed for educational planning." (Huckfeldt et al, 1973, p. 58) This would be true if the FPM were a purely comparative static model, in which all factors other than, e.g., federal student aid policy were held constant, or if the broader environment of higher education decisions were not in fact changing over time. However, as the recent examples of the Carnegie Commission and National

Center for Educational Statistics enrollment projections indicates, this environment is undergoing rapid change, and these changes must be incorporated in any attempt to predict the actual future consequences of any policy initiatives.[15]

It is particularly important that changes in the environment be incorporated in an analysis which is concerned with the differential effects of alternative policies on different classes of students, since the responsiveness of enrollment to various policy variables may be highly sensitive to changes in the environment, e.g., changing labor market conditions, and this sensitivity may well not be uniform for all classes of students. For example, a deterioration in the labor market for the highly educated may have much greater impact on the educational decisions of low-income than of high-income students. Alternatively, increased rates of unemployment for young noncollege-educated entrants into the labor force may encourage disproportionate numbers of low-income students to enroll, while having little impact on enrollment propensities of high-income students (Corazzini et al, 1972). It would be expected that a "national planning model" would at least recognize the importance of systematically incorporating (or at least investigating) this type of phenomenon. Admittedly, currently available data is inadequate to the task; but the documentation of the FPM indicates no appreciation for the possible necessity of representing the broader environment (e.g., changing labor market conditions, post-secondary educational options, etc.), and the model has not been designed to incorporate such elements if/as they become available. This is the first of many cases in which the FPM is based on a "1960s perception of the world," one in which none of the basic "parameters" of

the system undergoes significant change. The model's inadequacies in this dimension, it should be noted, constitute a major barrier to its extension to the broader postsecondary system.

A second drawback of the student demand component is that the probability of that a given student will choose to attend a particular type of institution is independent of his probability of admission. Radner-Miller incorporate this element implicitly through inclusion of both the student's SAT score and the mean score for the institutional type. However, in this "reduced form" (merging student unwillingness to enroll in too "high-powered" a school with the school's rejection of unqualified students) it is impossible to indicate the potential effect of a change in admissions standards which might accompany, e.g., a general decline in applications and enrollment.

Supply and demand interaction. Given student demand (by institution type, income and ability) and institutional supply of spaces (by the same characteristics, as discussed below), actual enrollment is assumed to be the lesser of the "quantity demanded" or the "quantity supplied." The difference between these is then "excess demand" (or negative excess supply). There is no scope in this system for student "recontracting," i.e., choosing a lesser quality school if he is not "admitted" to his first choice. Query: Is it reasonable to assume that a high-income, high-ability student will not attend any college simply because he is not admitted to a particular type of college, e.g., a high-quality private university?[16]

Similarly on the institutional side, if a particular sector faces inadequate demand by, e.g., low-income students, might it not admit additional high-income students, even stupid high-income students?

This possibility is completely excluded in the current form of the supply-demand interaction segment of the model. At the least it would appear that this segment should operate in a recursive fashion.

Institutional sector. Just as in the student sector, the institutional sector of FPM is designed for an environment of "stable growth." This growth emphasis is apparent in the assumption of stable faculty transition matrices, in the great weight given to augmentation of physical facilities, and in the discussion of possible "institutional objectives," relating to such alternatives as achieving prespecified rates of growth.

The bulk of the institutional model consists of transition matrices which determine the "carryover" of, e.g., faculty, students, and space from the preceding model year. This is seen quite clearly in the faculty segment, which simply employs fixed estimates of faculty retention and promotion to faculty present in the preceding year. While some attention is given to possible alternative methods of estimating the faculty transition matrix, no thought seems to have been given to the possibility that the transition matrix itself might be subject to institutional control and hence not amenable to incorporation in a parametric fashion.

The physical facilities segment is quite straightforward, carrying physical facilities in place or under construction through time, taking into account depreciation and completion rates. But one wonders at the major role this segment plays in a sector which will not experience in the future the rapid growth of the past.

The student segment raises questions similar to those regarding faculties. Can it be assumed that the transition probability from lower division to upper division status is "exogenous" to the institution, invariant with respect to institutional action? Do tuition and financial

aid policies really not influence persistence? Even if changes in institutional actions do not happen to alter the persistence of its students, is that behavior stable over time, invariant with respect, e.g., to labor market conditions? These are fundamental questions to which the authors make no serious reference.

The finances segment is clearly the most "complicated," partially because of the "overbuilt" construction segment and partially because the segment seems to have been designed for an accountant doing an audit.

Each of the foregoing segments could be subjected to much more intensive discussion and debate. However, it it more important to consider the mechanism which pulls these elements together, the institutional objective function. In briefest terms, an objective function consisting of the sum of squared deviations of actual from target values of various variables is minimized (over a five-year planning horizon), thus determining the "actual" values of the variables under the institution's control (students admitted--who may not actually appear, faculty hired, space put under construction, tuition, etc.). The questions which this procedure raises are legion. Does the institution truly control the "control" variables? Does the sign of the deviation of any variable from the target value really not matter to the institution? (E.g., is the institution indifferent between a $1 million cash surplus and $1 million cash dificit?) Are there really "target values" for many of these variables? Are these target values also constant over time? In general, does this optimal control framework really make any sense, or does it just permit an undetermined system to be determined? The author/designers agonize at

great length over the appropriate weights to be attached to various terms in the objective function and the appropriate target values for various variables but nowhere do they consider the basic relevance of the model's structure.

The structure, we are told, "makes the problem both relevant for polich analysis and tractable mathematically." (Huckfeldt et al, 1973, p. 48) In the sense that the model can be solved, it is mathematically tractable, but the same could be said of a virtually infinite number of alternative formulations, e.g., one which maximized a function of one or more variables, subject to constraints on the values of the remainder. In what sense is the particular optimal control model employed here more relevant for policy analysis than some other, as the authors have indirectly asserted? In short, there is no evidence to support this assertion since a) the authors have not examined alternatives and b) they have suggested no criteria by which the assertion could be judged.

From their porposals for further research one would judge that they would attempt to support their formulation by referenct to its "tracking power," i.e., by how well it could replicate the system. However, in the end this model has so many degrees of freedom, so many dials which could be turned to affect the outcome (i.e., the target values and weights in the objective function, already giving twice as many controllable parameters as there are variables to be determined, and all of the various transition coefficients), that given enough time the designers should be able to achieve almost any desired degree of accuracy for a period of up to, perhaps, a decade. In this context, "tracking" hardly provides a test of the model.

The problem, ultimately, is that as a planning rather than a research effort, FPM has been constructed from available items which could be picked up from the shelf, so to speak, e.g., the Radner-Miller student demand and Wagner-Weatherby institutional optimal control models. Such shelf items would be unobjectionable if one were constructing a standardized, well-known commodity, e.g., a dormitory, or if one recognized the very provisional nature of the final product and had formulated reasonable procedures for meaningful testing, for generation and comparative evaluation of alternatives, i.e. for actually attempting to understand the sector. But, as indicated, one looks in vain in the proposed program of further research for any real recognition that this type if process is necessary. What we are offered is a "bill of goods" from which one can select virtually any degree of extension, data refinement, testing, etc.

A multitude of more "trivial" questions about the model could be raised. For example, if the objective function includes the ratio of "instructional space" to "total space," can it conceivably make sense to then include a) instructional space and b) noninstructional space separately? That is, determining any two of these determines the third. This obviously constitutes a failure in logic, a failure incorporated only to meet mathematical requirements for solubility; hence the logical problem is much deeper. The same problem appears to arise in the student (proximity to forecast, upper and lower division), faculty/student ratio and faculty composition nexus, and may also be present in the various financial components. An adequate evaluation of the model in these technical terms would require a more extensive examination than is possible (or desirable) here; this evaluation would, however,

be facilitated if the procedures employed, requisite conditions for solution, etc., were adequately and explicitly provided by the authors.

At a more "substantive" level, the model specifically excludes consideration of noninstructional activities of institutions, e.g., research. (Huckfeldt et al, 1973, p. 19) However, the institutional supply of graduate spaces (assumed to be less than or equal to demand) is included. The only determinant of graduate supply is the inclusion of the difference between offered and target graduate enrollment in the objective function. The inadequacy of this procedure, ignoring the research and undergraduate facets of graduate supply, is obvious; a more reasonable procedure (but still inadequate if universities are to be included, since undergraduate supply is a function of the level of graduate enrollment) would have been to drop graduate enrollment entirely.

The designers' final agonizing over the appropriate measure for "equality of access," suggesting implicitly that there might exist a "correct" measure, is somewhat amusing. Obviously, there is no perfect measure, some measures may be more appropriate than others for some purposes, and one includes, purely as summarizing devices, a range of those deemed potentially relevant.

To state the obvious, FPM does not inspire confidence either as a planning tool or as an integrated program of further research. However, this indictment must be qualified somewhat. While it can be argued that the product of the effort does not justify the resources which have been devoted to it, that the model is largely arbitrary and ignores perhaps the most significant aspects of the postsecondary education system, and that it should not be taken seriously as a planning tool,

with all this said it can nonetheless be claimed that the consequence of the effort was not an absurdity. Although FPM is a dead-end branch in the process of evolutionary development of analytical capabilities rather than the first stage in a process of cumulative development, it will at least be able to claim the distinction of being the first comprehensive model of the higher education system. And its saving grace, ultimately, is its comprehensiveness; its data and conceptual demands are so great that it would be difficult for its designers, even if they so desired, to peddle its outputs as definitive answers to immediate policy questions. Unfortunately, no such restraints or inhibitions operated on the designers of the NCFPE Postsecondary Education Financing Model.

4.2 NCFPE Postsecondary Educational Financing Model

While PEFM is cast as only one component, the "analytical model," of the broader "analytical framework" developed to guide the National Commission (Carlson et al, 1974, pp. 9-23), the other elements of that framework are sufficiently confusing as to defy serious criticism. Discussion is restricted here to the model itself.

The model begins with NCES projections of the state of the post-secondary education system in future years (through the early 1980s). The function of the model is to predict changes in the future configuration of the system from these NCES "benchmarks" induced by specific policy actions.

Concretely, the benchmarks consist of projections of enrollment (lower and upper division undergraduate, graduate, and noncollegiate, the first further distinguished by two- and four-year institutions and

first three apportioned between public and private institutions), of tuition and financial aid, and of institutional costs and revenues (by source). The model then modifies student enrollment in response to specified federal student aid programs and stipulated institutional changes in tuition and financial aid.

For the flavor of the model, it is useful to trace through the sequence of operations (as described in Carlson et al, 1974, Chapter 3, pp. 33-80): A particular policy change (e.g., federal student aid program) is specified in terms of the level of awards to students with different incomes in different institutional environments. Furthermore, "new" tuition rates are specified, by type of institution and enrollment. The first stage of the model identifies the changes in enrollments resulting from the assumed changes in tuitions. It is then recognized that additional tuition revenues may be channeled into additional institutional student aid, and the proportion thus channeled is stipulated. A second change in enrollment is then calculated, taking into account the effects of increased tuitions and institutional aid to students. The final stage in the enrollment calculation then incorporates the effect of the stipulated federal aid program, resulting in the "final" projections of enrollment change.

Before reviewing the subsequent, derivative operations of the model it is useful to examine the enrollment facet in some detail. First, the effects of changes in net tuition on enrollment are computed from partial derivatives of the proportion of an income-ability group enrolled with respect to tuition, as obtained from Radner-Miller. However, there is no indication that the NCFPE-modified NCES enrollment and tuition projections are consistent with the Radner-Miller model. Thus, the NCFPE-modified Radner-Miller coefficients are applied to change enrollments from levels

which may in fact be inconsistent with the coefficients. Because the PEFM policy projections are based upon the NCES projections and the Radner-Miller demand study, the former can be no better than the latter, which ignore the labor market and other influences on demand discussed above; but PEFM may even be worse if NCES and Radner-Miller are incompatible, as is likely.

Second, although the Radner-Miller coefficients were estimated on the basis of first-time enrollments of high school graduates, PEFM employs effectively the same coefficients for continuing students; this might be (but is not) justified on grounds that it captures the effect in year t of a policy change introduced in, e.g., year t-4, assuming that post-freshman enrollments are not at all responsive but treating them as if they were to capture the earlier effect of a policy. However, this interpretation is inconsistent with the nominal dating of the specified policy change. While it may be quite wrong to assume that persistence is completely unresponsive to tuition-aid change, as required by the first interpretation, it is probably even worse to assume that upper-class enrollments are as price-responsive as freshman enrollments, the alternative interpretation of the model. If, as appears to be the case, the second interpretation was intended, the model never addresses the question of where the additional upperclass enrollment comes from, e.g., to be a junior in college, one must have been a freshman and sophmore some time in the past. Is there, perhaps, a "reserve army" of all prior dropouts? It is pointless to even raise the question of the source, much less meaningfulness, of the graduate and non-collegiate price elasticities.

Third, as indicated, the "tuition changes," and also the fractions

of additional tuition revenues devoted to student aid, are stipulated by the user of the model. Thus, while the model is used to assess the effects of alternative federal student aid programs, the results are no more meaningful than the "analyst's" stipulation of tuition changes and aid allocations, the criteria for which are nowhere disclosed.

Finally, a "quibbling" objection: While the "second" change in enrollment, i.e., the change which is predicted after taking into account the student aid effect of the tuition change, includes in the tuition base the contribution of the institutionally-aided student, the additional tuition revenue resulting from the final enrollment change induced by federal aid does not result in further institutional aid and hence enrollment. Since the actual dollars (or students) could not in fact be differentiated by the institution, this seems to be an arbitrary internal inconsistency of the model, incorporated only to lighten the computational load, the seriousness of which is not assessed.

In short, since the intelligence emerging from a model can be no greater than that entering it, the enrollment effects of federal policy changes predicted by PEFM cannot be considered of sufficient legitimacy as to be of any value in the assessment of alternative policies.

Although tuition (and associated institutional student aid) and federal student aid changes are the only effective instruments in the model, i.e., the only sources of enrollment change, PEFM in fact goes somewhat further. First, it incorporates new federal and state institutional aid programs, either block grant or per student (or per student for some subset of students, e.g., those receiving federal aid). These programs, however, have no operational significance, i.e., induce no changes in tuition, institutional aid to students, or enrollment. The model also projects

changes in cost, multiplying changes in enrollment by average costs, assuming constant average costs by institutional type. Finally, net increases in deficits are computed, subtracting increased tuition revenue and institutional aid from the increase in costs, and these increased deficits are then distributed to federal, state, local and private funding sources according to their shares of benchmark non-tuition revenues, permitting the model to reach such conclusions as: "... a public policy of using student aid to expand enrollments (thereby inducing institutional costs) while at the same time reducing direct institutional support is clearly in conflict with itself." (Carlson et al, 1974, p. 45; see also pp. 130-133) This startling and "counter-intuitive" conflict, however, dissolves when the arbitrary nature of the stipulated tuition changes is recalled.

In short, it is difficult to find any "redeeming social value" in the National Commission's model. The most serious threat is that it may be taken seriously by public officials either overawed by its apparent analytical power (a response encouraged by the unctuousness of the model's presentation) or sufficiently cynical to use its irrelevance to support preordained conclusions.

5. Conclusion

From the foregoing I conclude that these two studies, as representative of available research in modelling the system of higher education, have major weaknesses at a conceptual level and at the level of empirical implementation. I would go further and suggest that the empirical problem is, to a high degree, a function of the conceptual failings. Until a meaningful conceptual basis has been developed, postsecondary education will continue to fall prey to such analytical excesses as PEFM, and these will

dominate not only policy discussions but also "research" and data collection. The paucity of existing knowledge and understanding must be exposed, not covered over with reams of computer output.

REFERENCES

Astin, A. College Dropouts: A National Profile, Washington, D. C.: American Council on Education, 1972.

Bowles, S. "Aggregation of Labor Inputs in the Economics of Growth and Planning: Experiments with a Two-Level CES Function," Journal of Political Economy 78 (January/February 1970): 68-81.

Brown, H. J., Ginn, J. R., James, F. J., Kain, J. F., and Strasgheim, M. R. Empirical Models of Urban Land Use: Suggestions on Research Objectives and Organization, Exploratory Report 6, National Bureau of Economic Research, New York: Columbia University Press, 1972.

Campbell, R. and Siegel, B. N. "The Demand for Higher Education in the United States, 1919-1964," American Economic Review 57 (June 1967): 482-94.

Carlson, D. E., Farmer, J. and Weathersby, G. B. A Framework for Analyzing Postsecondary Education Financing Policies, Staff Report of the National Commission on the Financing of Higher Education, Washington, D. C.: U.S.G.P.O., 1974.

Carnegie Commission on the Future of Higher Education, Priorities for Action, New York: McGraw-Hill, 1973.

Cooley, W. W. Career Development of Scientists, An Overlapping Longitudinal Study, Cooperative Research Project No. 436, Cambridge, Mass.: Graduate School of Education, Harvard University, 1963

Corrazini, A., Dugan, D. J., and Grabowski, H. "Determinants and Distributional Aspects of Enrollment in U. S. Higher Education," Journal of Human Resources 7 (Winter, 1972): 39-59.

Crean, J., Jr., "Foregone Earnings and the Demand for Education: Some Empirical Evidence," Canadian Journal of Economics 6 (February 1973): 23-42.

Denison, E., "The Shift to Services and the Rate of Productivity Change," Survey of Current Business 53 (October 1973): 1-37.

Dougherty, C., "Estimates of Labor Aggregation Functions," Journal of Political Economy 80 (November/December 1972): 1101-1119.

Dresch, S. P., An Economic Perspective on the Evolution of Graduate Education, Technical Report Number One, Washington, D. C.: National Board on Graduate Education, 1974.(a)

_____, "Research, Graduate Education and the University," Educational Record 55 (Summer 1974): 171-176. (b).

_____, "The College, the University and the State," in New Directions for Higher Education (forthcoming, 1975) (a)

_____, "Demography, Technology and Higher Education: Toward a Formal Model of Educational Adaptation," Journal of Political Economy 83 (March/April 1975, forthcoming). (b).

_____, "Educational Saturation: A Demographic-Economic Model," AAUP Bulletin (1975, accepted subject to revision). (c)

Fallon, P. R., and Layard, P. R. G., "Capital-Skill Complementarity, Income Distribution and Output Accounting," Journal of Political Economy 83 (1975, forthcoming).

Fetters, W. B., National Longitudinal Study of the High School Class of 1972: A Capsule Description of High School Seniors, Base Year Survey, Washington, D. C.: U.S.G.P.O., 1974

Forrester, J. W., Industrial Dynamics, Cambridge, Mass: MIT Press, 1961.

_____, Urban Dynamics, Cambridge, Mass.: MIT Press, 1969.

_____, World Dynamics, Cambridge, Mass.: Wright-Allen Press, 1971.

Freeman, R. B., The Market for College Trained Manpower: A Study in the Economics of Career Choice, Cambridge, Mass.: Harvard University Press, 1971.

Galper, H., and Dunn, R. M., "A Short-Run Demand Function for Higher Education in the United States," Journal of Political Economy 77 (September/October 1969): 765-777. .

Griliches, Z., "Capital-Skill Complementarity, " Review of Economics and Statistics 51 (November/ 1969): 465-468.

_____, "Notes on the Role of Education in Production Functions and Growth Accounting," in W. Lee Hansen, ed., Education, Income and Human Capital, New York: Columbia University Press, 1970, 71-115.

Habermas, J., Toward a Rational Society; Student Protest, Science and Politics Boston, Beacon Press, 1970.

Hoenack, S., "The Efficient Allocation of Subsidies to College Students," American Economic Review 61 (June 1971): 302-311.

Huckfeldt, V., Weathersby, G., and Kirschling, W., "A Design for a Federal Planning Model for Analysis of Accessibility to Higher Education," Boulder: NCHEMS-WICHE, 1973

Jaffe, B. A., and Adams, W., "Trends in College Enrollment," College Board Review 55 (Winter 1964-65): 27-32.

Jevons, H. S., The Sun's Heat and Trade Activity, London. P. S. King, 1910.

Kaun, D. E., "The College Dropout and Occupational Choice," in Margaret Gordon, ed., Higher Education and the Labor Market, New York: McGraw Hill, 1974.

Kohn, M. G., Manski, C. F. and Mundel, D. S.,"An Empirical Investigation of Factors Which Influence College Going Behavior," Washington, D. C.: Rand Corporation, 1974.

Lotka, A. J., Elements of Mathematical Biology, New York: Dover, 1956 (first published as Elements of Physical Biology, 1924).

McFadden, D., "Conditional Logit Analysis of Qualitative Choice Behavior," in Paul Zarembka, ed., Frontiers in Econometrics, New York: Academic Press, 1974.

Meadows, D. H., Meadows, D. L., Randers, Jorgen, and Behrens, W. W., III, The Limits to Growth, New York: Universe Books, 1972.

Migue, J.-L. and Bédanger, G., "Toward a General Theory of Managerial Discretion," Public Choice 17 (Spring 1974): 27-43.

Miller, L. S., "Demand for Higher Education in the United States," Conference on Education as an Industry, New York: National Bureau of Economic Research, 1971.

National Center for Educational Statistics (NCES) Projections of Educational Statistics to 1980-81, Washington, D. C.: U.S.G.P.O., 1972.

_____, Projections of Educational Statistics to 1981-82, Washingnon, D. C.,: U.S.G.P.O., 1973.

National Commission on the Financing of Postsecondary Education (NCFPE) Financing Postsecondary Education in the United States, Washington, D.C.: U.S.G.P.O., 1973.

Nelson, R. R., "Intellectualizing about the Moon-Ghetto Metaphor: A Study of the Current Malaise of Rational Analysis of Social Problems," Working Paper W3-28, New Haven: Institution of Social and Policy Studies, Yale University, 1973.

_____, and Krashinsky, M., "Public Control and Economic Organization of Day Care for Young Children," Public Policy 22 (Winter 1974): 53-75.

Niskanen, W., Bureaucracy and Representative Government, Chicago: Aldine, 1971.

Nolfie, G. J. and Nelson, V. A., Strengthening the Alternative Postsecondary Education System: Continuing and Part-Time Study in Massachusetts, Cambridge, Mass.: University Consultants, Inc., 1973.

Psacharopoulos, G. and Hinchliffe, K., "Further Evidence on the Elasticity of Substitution between Different Types of Educated Labor," Journal of Political Economy 80 (July/August 1972): 786-792.

Radner, R. and Miller, L., "Demand and Supply in U. S. Higher Education: A Progress Report," American Economic Review 60 (Papers and Proceedings, May 1970): 326-334.

Spies, R. R., The Future of Private Colleges, Princeton, N. J.: Industrial Relations Section, Princeton University, 1973.

Tinbergen, J., "Substitution of Graduate by Other Labor," Kyklos 27 (No. 2, 1974): 217-226.

Wagner, W. G. and Weathersby, G. B., "Optimality in College Planning: A Control Theoretic Approach," Office of the Vice President-Planning, University of California, 1971.

Youn, T. I. K., and Thompson, R., "A Summary and Analysis of the National Commission's Survey of Noncollegiate Institutions," in G. Weathersby and D. Nash, eds., A Context for Policy Research in Financing Postsecondary Education, Staff Report of the National Commission on the Financing of Postsecondary Education, Washington, D. C.: U.S.G.P.O., 1974.

FOOTNOTES

The author is director of Research in the Economics of Higher Education and lecturer in economics and the Institution for Social and Policy Studies, Yale University, and a research associate of the National Bureau of Economic Research. An earlier version of the paper was prepared for the U.S. Office of Education. Preparation of the paper and the research upon which it is based have been supported by a grant to Yale from the Alfred P. Sloan Foundation. The paper has not undergone the critical review, including review by the board of directors, accorded studies of the National Bureau of Economic Research and hence is not an official publication of that organization.

1. As cited by Alfred J. Lotka (1956, p. 300).
2. Richard R. Nelson (1973) provides a general critique of several recent schools of thought which have attempted to develop "scientific" solutions to vexing social problems.
3. See Jay W. Forrester (1961;1967;1971) and Donella Meadows et al (1972).
4. For a detailed critique of this approach as it has been applied to urban transportation planning, see H. James Brown et al (1972, pp. 78-95).
5. These issues are considered in a more general context in Stephen P. Dresch (1974b).
6. Bowles (1970), Griliches (1969; 1970), Dougherty (1972), and Psacharopoulos and Hinchliffe (1972) provide representative studies of the relationship between the educational composition of the labor

force and the relative earnings of different educational groups. Tinbergen (1974) and Fallon and Layard (1975) go further, combining models of relative wage determination with models of the supply of educated labor. However, only Dresch (1975b) presents a model which explicitly incorporates demographic factors in the supply of educated labor, although his demand model is less full articulated than that of Fallon and Layard and, as pointed out by Tinbergen, perhaps results in an upward bias in the demand for educated labor.

7. This "quasi-projection" of educational attainments of young people, developed in Dresch (1975b), implies a contraction in college enrollments of 45% between 1980 and 1990 and of 33% between 1970 and 2000, contrasting sharply with the popular "trend-demographic" projections, e.g., the Carnegie Commission on the Future of Higher Education (1973) and the National Center for Educational Statistics (1972; 1973). While the quasi-projection incorporates labor market developments, the trend-demographic projections are simply derived by applying extrapolations of the proportions of relevant age cohorts enrolled to estimates of the future size of these cohorts.

8. A number of more technical, but equally serious, problems infect the Niller-Radner and Kohn et al studies. Formally, the most important problem in the estimation of their "contitional logit" models is McFadden's "Axiom 1 (Independence of Irrelevant Alternatives)... [which] states that the odds of y being chosen over x in a multiple choice situation B, where both are available, equals the odds of a binary choice of y over x."(McFadden, 1974, p. 109) This assumption is clearly violated in both studies; consider the relative odds of choosing a particular community college over a particular

university when a) there are no other alternatives and b) there exists a second community college across the street from the first.

9. It should be noted that Corazzini et al (1972) do estimate separate demand equations for four socioeconomic quartile groups, with resultant parameter estimates as relevant for policy analysis as those provided by Radner-Miller and Kohn et al. This raises a general point about the distinction between aggregative and micro-level studies: While the former are concerned with the proportions of particular groups enrolled, the latter focus on the probability that a particular individual will enroll, but this is not an essential difference. If the groups in the "aggregative" studies were sufficiently homogeneous internally, i.e., if all members had the same characteristics and faced the same opportunities, then the difference would simply be one of estimation technique.

10. This statement obviously refers to higher education at a fairly aggregative level; marked changes did occur, e.g., in labor market conditions facing persons in particular fields, and student and institutional responses to these changes were quite significant. As indicated by Freeman's (1971) study, had these processes been studied in greater depth, our knowledge of the role of environmental variables and of their perception by students would be much stronger than it now is.

11. The importance of tracking cohorts from a very early age, even the seventh grade, is very clearly indicated in Cooley's study of scientific career formation.

12. This is the general scope of a major study recently undertaken by the author as part of Yale's program of Research in the Economics of Higher Education under the title "Labor Market Conditions/Perceptions,

Career Plans and Educational Decisions." The first stage of this study has involved an extensive survey of applicants to three academically high-quality institutions. In addition to survey responses the data base includes admissions and financial aid applications' information. Future stages will involve 1) resurveys of the 1974 respondents and 2) surveys of successive cohorts of applicants. We are currently in the process of modifying and extending the questionnaire for administration to representative samples of high school graduates, obtaining extensive information on those not planning to attend college.

13. While the similarities between these two models might appear to give the weight of numbers to their formulations, "interlocking directorates" would seem to provide a better explanation of their similarities than would their analytical solidity. Thus, for example, Ben Lawrence served as executive director of the NCFPE while on leave from the directorship of NCHEMS. Formerly with the Office of Analytical Studies of the University of California, George Weathersby, NCFPE director of research and joint author of the PEFM design report (Carlson, Farmer and Weathersby, 1974), was also a participating author of the FPM design volume (Huckfeldt, Weathersby and Kirschling, 1973) and coauthor of an earlier study which provided the basis for the institutional component of FPM (Wagner and Weathersby, 1971). James Farmer, a PEFM author, served on the staff of NCHEMS prior to joining the National Commission, and returned to NCHEMS as a consultant. Daryl Carlson, also a PEFM author, served on the NCFPE staff while on leave as assistant professor of agricultural economics at the University of California, Davis, and had previously been associated with Weathersby at the UC Office of Analytical Studies. The point is simply, that one would expect the same basic group of people to approach these issues

in a similar manner.

14. However, in an October 1974 conversation with the author, Huckfeldt indicated that this aspect of the model has subsequently been modified, although no written description of the revision is yet available.

15. Thus, the 1971 NCES projection of enrollment, 1970 to 1980, of 55% (NCES, 1972) was followed by a 1972 projection of only 43% (NCES, 1973). Similarly, the Carnegie Comission 1970-1980 projection of enrollment growth declined from a 1971 Projection I of 49% to a 1973 Projection II of 31%; for the period 1970-2000 the revision was from 90% to 51% (Carnegie, 1973). These year-to-year variations indicate the magnitude of the environmental forces, the effects of which are incorporated in the basic projections only post hoc.

16. As noted above, footnote 14, a later version of FPM is said to have loosened this restrictive feature of the model's allocation of students to institutions.